Research Archiving As a Tool for Research Continuity: A Look at Bowen University, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The concept of research/project archiving revolves around access to and storage of past works. With the increase in technology, several universities have incorporated the use of electronic archive systems to store research works to provide easy access to such works and improve their research output. Bowen University, Nigeria however, currently runs a manual system of project archiving which is not in tune with the current trend in research archiving. This work was therefore aimed at designing an electronic project archive system for Bowen University that provides accessibility to securely managed past works to cater for the research needs of undergraduate students and enable them to contribute their quota to knowledge.
Study Design: An empirical research study design was employed.
Place of Study: Bowen University, Iwo, Nigeria.
Methodology: A self-constructed questionnaire designed via Google Forms was administered to current students, past students and staff members of Bowen University to collect data on user requirements; data were analyzed and the results served as a platform to develop a user-centred system.

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The Bowen University Project Archive System (BUPAS) was built with a focus on the authenticity of the materials archived using HTML for the user interface design, PHP for the system logic to communicate with a carefully designed and structured database, and a local host server, WAMP providing back and forth communication. The usability test was also conducted for users.

Conclusion: The use of the agile methodology ensured the development of a fully functional system that provides a faster and easier platform for submitting and accessing project works with users attesting to the need for the system and commending the simplicity and easy navigation of the system. Also, a major strength any archive system should possess is its ability to ensure a secure way of depositing into it to guarantee the authenticity of materials that are being accessed. The Bowen University Project Archive System possesses this strength.

1. INTRODUCTION

In recent years, the priority placed on archiving has increased as it relates to legal issues that can prove the authenticity of issues relating to a particular organisation; giving a clearer view of "the story of the community and its people, their successes and the issues that they believe to be important" [1,2]. David [2] and John [3] noted that "Archives have also always been at the intersection of past, present and future"; this is because archives give an understanding of the past, control the present and serve as a basis to make a plan. The classification of knowledge into its two basic forms has enabled researchers to distinguish between the use of active knowledge and the relevance of passive knowledge in the growth and availability of positive knowledge. An archive falls into the category of passive knowledge and the quest to ensure the consistent availability while sustaining authenticity of the ever-increasing reservoir of passive knowledge has increased research opportunities in the field of archiving [4].

The need for archives as a tool for research continuity coupled with its unique feature of preserving and delivering authentic records spurred the idea behind developing an electronic project archive system using Bowen University as a case study (BUPAS).

2. RELATED WORKS

The advent of technology and its constant incorporation into the field of archiving affords several advantages as well as issues which are constantly considered and surmounted [5,6,7,8]. Issues ranging from the fact that Archivists have to deal with the implications of non-restriction of the use of portable technological devices when visiting an archive [8], to the Representation systems of digital archives (considering the several yardsticks necessary in the development and maintenance of archives) [6], and Answering the various questions relating to the preservation of records considering the format, increasing volumes of record, sensitivity of records, security, usability and reusability, and at the same time leveraging on information technology to support activities [9]. Not neglecting the concept of Archival description which involves describing an archive in terms of its representation, identification and organization to ensure that a specific type of archive meets its user's specification [5].

Despite the several challenges highlighted, the need for archives as a tool for research continuity coupled with its unique feature of preserving and delivering authentic records compared to other institutions of information preservation cannot be overemphasized. Hence, resulting in the continued effort made in surmounting these challenges [10]. Nengomasha [7] suggested a need for measures to be put in place in ensuring that policies guiding the management of archives are not just given but are strictly adhered to. If such is not done the several issues which have been highlighted in the past that have found their way to the present have a high probability of getting to the future irrespective of the incorporation of new technology into the development of archival systems [7]. Furthermore, Rolan [11] stated that in enhancing the ease of use of archival systems, interoperability has to be a determining factor in choosing a sustainable framework for the development of an archival system. As such, there is a need for a control framework in enhancing the sustainability of archival systems.

In 2006, [12] proposed a set of epistemological principles for the archival information system as a basis for the development of a six-layered level framework based on the incorporation of Records continuum model and Open Archival Information System (OAIS) reference model to produce levels of substitutionally. He argued that the essence of an archive is defined by the accessibility and as such there must be a balance between preservation and accessibility.

In 2017, a theoretical framework to analyze an archive in terms of its origination, construction, usage and continued management with regards to the peculiarity of the users in synchronization with the type of record being archived was developed. Based on several assumptions, a 5-component framework (Archive-As-Is) was developed. The four dimensions of information, the two archival principles and five requirements of information access served as components A, B and C respectively and are expected to fit into the value chain (D) and be supported by the organizational behaviour (E) [13].

Also, ERA; a 21st-century repository for National Archives and Record Administration (NARA) was built on the foundation of information management architecture for persistent object preservation in collaboration with electronic record archives framework. "Although OAIS and International Research on Permanent Authentic Records in Electronic Systems (InterPARES) served as the foundations of the ERA program, the core of the program stems from the Distributed Object Computation Testbed (DOCT)" [9,10].

SITools2 framework; a subsidiary to SITools built on a client/server architecture was developed to offer common services through an "easy-to-use open-source web platform" to help the scientific community provide data access to their experiments; it provides some services by default and also owns some extension points that can host specific plug-ins [14].

In several academic institutions, research archives have been used particularly to house research works to foster research continuity. Schools noted for their interest in research are seen to have established archives for this cause [15-19,20]. To this effect, Jain & Oladiran [21] stated that "In this electronic publishing age, academic institutions including universities have increasingly recognized that an institutional repository (IR) is an essential infrastructure of scholarly dissemination".

With the evolution of data library software, Research archives' development has embraced the use of this software as a framework for development while considering the most prioritized development criteria and several external factors to the institution involved [16,17].

Massachusetts Institute of Technology (MIT) has a research archive which is based on the Dspace framework developed by the institution. It consists of three layers; application, business and storage layers which operate to meet the variety of digital archiving need [18]. Oxford Research Archive (ORA), a secure and permanent academic repository for members of Oxford University provides a platform to maximize the university's research output using a flexible service-oriented architecture which incorporates Fedora as the middleware linking the storage and delivery applications [15,19]. The repository is populated using the Author Accepted Manuscript (AAM) quick deposit approach, Symplectic approach or Metadata deposit approach [1].

Similarly, the Leicester Research Archive (LRA) caters for the secure storage of and access to research publications authored by members of the university [1]. It operates a policy which integrates the university archive collection management with record management framework [1,22].

In terms of information retrieval, several search algorithms are incorporated to enhance sorting and searching; although there is a need to analyze the effect of data library software on the search algorithms [16].

Irrespective of the archive's location, the use and the method of archiving, archivists have constantly been fascinated by the design of a framework to ease accessibility while ensuring that the policies are not neglected and ensuring specific organizational satisfaction [5,6].

3. METHODOLOGY

This section examines the user and system requirements for successful deployment of BUPAS to achieve a user-centred system. It reports the elicitation method used and analyzes the data collected from the intended users as regards the development of the BUPAS.

For requirement elicitation, the use of the questionnaire provided the researcher with the

best technique to reach the intended users due to the difference in locations. The questionnaires were designed using Google forms, an online survey tool provided by Google. The generated links were sent via e-mail and other social media platforms to the intended users. Data collected from the questionnaire were exported from Google forms to IBM SPSS Statistics version 20 for analysis. Tables and charts from the SPSS analysis are reported and explained. Table 1 below gives a description of the four sets of users identified and their relevance to the requirement elicitation process. Table 2 gives an analysis of students' responses.

Of the 120 respondents, a greater proportion of 115 [95.5%] stated that they will need to consult other people's project to effectively work on their own project. This reflects a need for an easily accessible online archive.

A greater proportion, 114[95.8%] of the respondents highlighted the desire to be able to access their projects online upon graduation.

A greater proportion, 108[91.5%] of the respondents will be glad to see their project improved upon after graduation. This is more feasible when projects are online.

In terms of the recommendation of the system to other universities in Nigeria, a greater proportion, 113[95%] of the respondents will recommend the system. This reflects the level of appreciation for the relevance of the system.

A greater proportion, 105[89%] of the respondents will be willing to assist current students working on a similar topic after they graduate. This becomes easier with an online archive.

As regards other reasons why the project archive system should be developed, students summarily gave the following reasons:

- To aid the quality of research and contribution to knowledge.
- To aid referencing.
- To keep students in tune with the latest happenings in their fields of study.
- To assist students in understanding the requirements for a successful project.
- To help reduce plagiarism.
- To avoid the repetition of past projects.

From Fig. 1, respondents (120) ranked the important features of the system as follows: Ability to view a project ranked highest (99[83.2%] respondents); Then Ability to download a project (56[47.1%] respondents). This is followed by the ability to upload a project (50[42%] respondents).

From Fig. 2, respondents rated the qualities they think the system should possess as follows: Easy way to access projects (91[78.4%] respondents), 24 hours' access to projects (72[62.1%] respondents), Multiple access to a single project at the same time (66[55.9%] respondents), Disallow any form of laziness from students (46[39.7%] respondents). Other ranked lowest with just one respondent [0.9%].

From Fig. 3, respondents rated ways to search for a project as follows: By project title (88 [75.2%] respondents); By student's name (70 [59.8%] respondents); By department (59 [50.4%] respondents); By keywords (58 [49.6%] respondents); By supervisor's name (30 [25.6%] respondents) and Other (2 [1.7%] respondents).

Table 1. User identification

User	Description	Essence
USER 1	Bowen University Current Students	To understand what the students would want the system to do and to ascertain the relevance of the system.
USER 2	Bowen University Past Students	To know if the system would have been of help if it was available before they graduated and to serve as mouthpiece for the general public.
USER 3	Academic Staff Members of Bowen University	To understand the functions staff members would expect the system to perform and to ascertain the necessity of the system.
USER 4	BUPAS Administrator	To help manage and maintain the system

Table 2. Analysis of students' responses

S/N	Question	Yes [%]	No [%]	I Don't Know [%]
1	Do you think you will need other people's project to help you work effectively on your final year project?	115[95.5]	1[0.8]	4[3.3]
2	Would you love to be able to access your project after you a have graduated?	114[95.8]	2[1.7]	3[2.5]
3	Will you be glad to know that your project work was improved upon after your graduation?	108[91.5]	3[2.5]	7[5.9]
4	Will you recommend such a system to any university in Nigeria?	113[95]	3[2.5]	3[2.5]
5	Give other reasons why you will think the project archive system should be developed?	Reported Below		
6	Will you be willing to assist current students working on a similar topic after you graduate?	105[89]	2[1.7]	11[9.3]

From the data gotten from the users, the following were discovered and represented in natural language to satisfy the users' needs.

- All users can search, view and download projects.
- The administrator has the permission to create, read, update and delete records in the database.
- The administrator can assign students to staff members.
- Staff members can generate code for students to submit projects.
- Staff members can control the projects to be archived.
- Final year students can submit projects.
- Final year students can view their project status.

The use case diagrams were used to show individual and collective users activities. The users can all search for projects using any of the filters e.g. author, project title etc. They can also view, and download a project. Fig. 4 shows the activities that can be performed by all.

3.1 Functional Requirements

The BUPAS has nine (9) functional requirements which are explained below;

- The system has a platform for implementing user requirements.
- The system has a platform to search for the project using several search filters e.g. keywords, supervisor's name, student's name and year of graduation.
- The system possesses a platform for retrieval of historical data, past projects.

- Authentication: The system can distinguish between staff and students to ensure that the projects are approved and authentic.
- Scalability: BUPAS is a data-intensive system and as such plans must be made for expansion.
- Data integrity: To ascertain the authenticity of materials in the archive.
- Security: Security checks were put in place to ensure that only authorized members of the university are permitted to perform specific duties.
- Ease of use: The system's graphical user interface was designed in conformance to usability standards to enable the users to enjoy interacting with the system.
- Availability and Reliability: To provide 24 hours' system access irrespective of the location of the user.

4. IMPLEMENTATION

The BUPAS is an open access system that allows users to search, view and download research projects carried out by final year students of Bowen University. It provides a secure platform for easier and faster submission of projects. Based on the analysis done under methodology, the work adopted various development tools to produce the desired output; this is shown in Table 3 while the system interface is presented in Fig. 5.

4.1 System Testing

System testing deals with the overall testing of the complete system to ensure its conformance to the requirement specifications earlier stated. System testing on BUPAS was carried out and

all the requirements were successfully realized as shown in Table 4. As such, in terms of conformance specification, the various requirements were highlighted and the system has proven to implement all the requirements earlier stated.
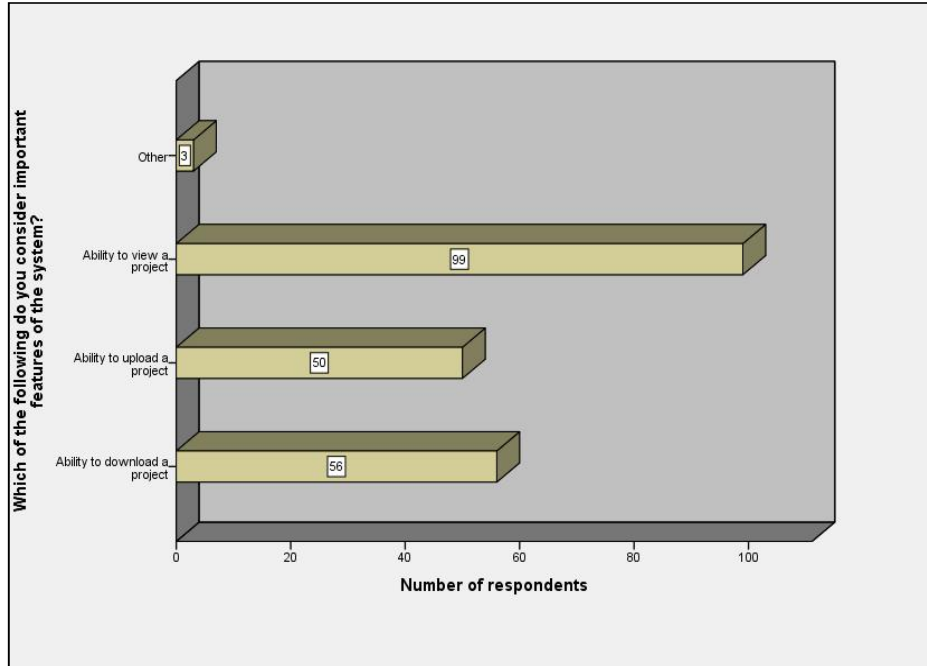

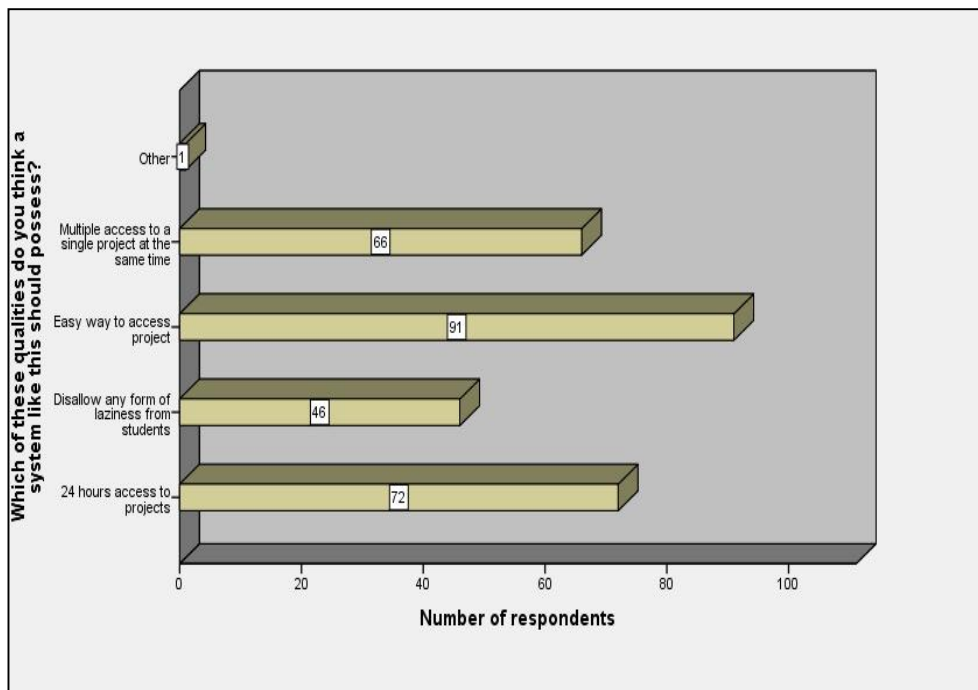**Fig. 1. Important features of the system**
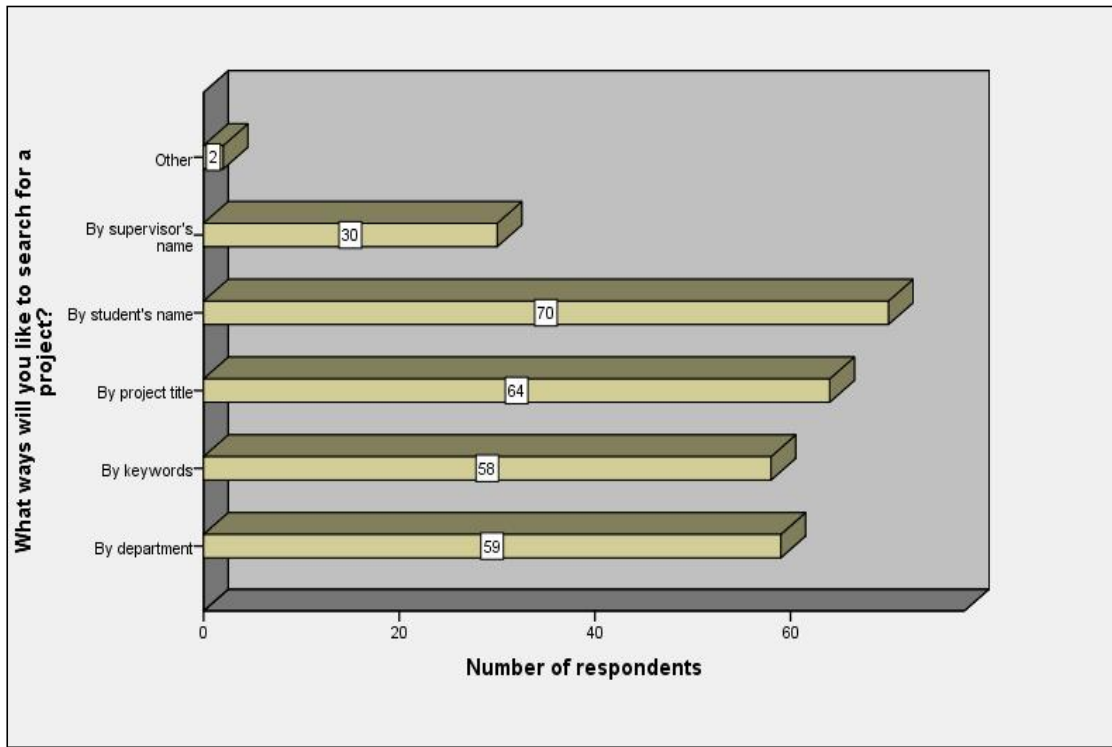

Fig. 2. Qualities the system should possess

Fig. 3. Ways to search for a project

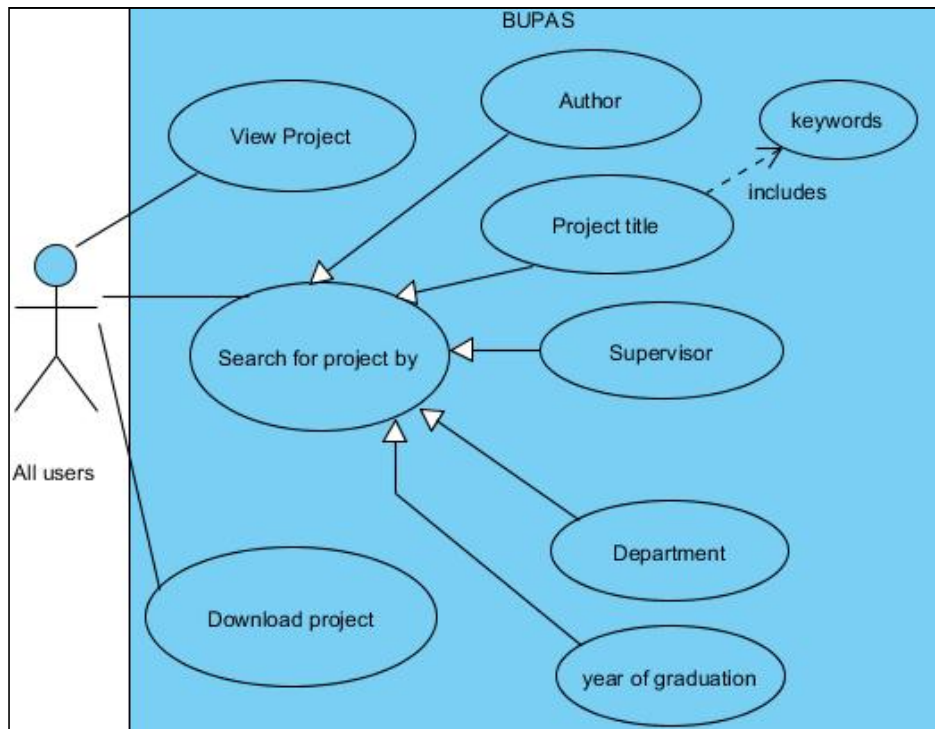**Fig. 4. Use case showing all users' activities**

Table 3. Showing BUPAS development tools

Function	Tools	Reason for selection
Development methodology	Agile methodology	Its functionalities are aimed at improving user satisfaction by ensuring user requirements are top priority and by adopting the incremental-iterative model in execution
Operating system/platform	Windows	A platform known for its strength in terms of cost, flexibility and availability
Design tools	UML Dreamweaver Visual paradigm	Easy to use tools that excellently represent the researcher's ideas
Programming languages	HTML CSS Java Script PHP SQL	Apart from HTML and SQL being standards, the complementary advantages of the others help to enhance system functionalities
Code editor	Notepad ++	A free source code editor that is easy to use
Database management tools	MYSQL	It supports various programming languages and is supported by several operating systems
Application server	WAMP	A platform that helps to integrate all the chosen tools
Administrator tool	PhpMyAdmin	An easy to use tool for prompt administration functionalities

Fig. 5. BUPAS graphical user interface

Table 4. Requirement and realization

Requirement	Realisation
All users are able to search, view and download projects	Successful
The administrator has the permission to create, read, update and delete records in the database	Successful
The administrator is able to assign students to staff members	Successful
Staff members are able to generate codes for students to submit projects	Successful
Staff members are able to control the projects to be archived	Successful
Final year students are able to submit projects	Successful
Final year students are able to view their project status	Successful
The system has a platform to search for projects using several search filters e.g. keywords, supervisor's name, student's name and year of graduation	Successful
The system possesses a platform for retrieval of historical data, past projects	Successful
The system can distinguish between staff and students to ensure that the projects are approved and authentic	Successful

Table 5. Test for effectiveness of system

Task Number	User 1	User 2	User 3	User 4	User 5	Success	% completed for each task
1	✓	✓	✓	✓	✓	5	100
2	✓	✓	✓	✓	✓	5	100
3	✓	✓	✓	✓	✓	5	100
4	✓	✓	✓	✓	x	4	80
5	✓	✓	✓	✓	✓	5	100
6	✓	✓	x	✓	✓	4	80
% success per user	100	100	83.33	100	83.33		

4.2 Usability Testing

The usability testing is aimed at assessing the system in terms of effectiveness, efficiency, learn ability and satisfaction. The usability testing is presented in Table 5. To test for efficiency, the optimal number of clicks to accomplish a particular task was computed against the number of clicks by individual users. Thereafter, the average number of clicks was found. To test for effectiveness of the system, the level of success of every user was computed against the level of success of all the users on particular tasks. In terms of learn ability and satisfaction, users were able to navigate easily through the system and commended the system for this.

4.3 Performance Analysis

Performance check was done to ensure that the increase in the number of users and the amount of data do not affect the speed and effectiveness of the system. The performance analysis showed that the system performed optimally and is fit for use.

5. CONCLUSION

This research has helped in emphasizing the importance of electronic archives especially in academia. It is hoped that this will prompt Nigerian universities to incorporate the use of electronic archive systems in their research endeavours.

When compared to LRA and ORA, BUPAS is a project archive specifically designed for undergraduate students of Bowen University that provides a simple platform to easily search for materials which means its features cannot be as complicated as the LRA or ORA. The researchers think implementing a system like the BUPAS to a Nigerian university is an entirely new concept is a step in the right direction.

However, the BUPAS has some possible areas for improvement. For future research, a platform

for digital archiving can be incorporated into the system which will enable the upload of pictures, audio, video and related materials as the current system only handles documents. The incorporation of symplectic element tool can also be looked into; which makes depositing of materials easier and faster by allowing previous depositors refer to the last deposited material and by so doing, their bibliography is simply transferred to the new material they are attempting to deposit. BUPAS does not currently possess this feature because the system makes provision for just one submission per student in line with the university policy. Expanding the system to accommodate depositing by postgraduate students and staff will require this desirable tool as these sets of people may need to deposit more than one material.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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